

Global Warming Solutions for California Cars

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Methodology

- Baseline emissions
 - Based on certification data
 - CH₄ and N₂O estimated from relationship with NOx and NMOG
 - Refrigerant and indirect CO₂ emissions estimated
- Modeling
 - Modal Energy and Emissions Model (MEEM)
 - Modeled 2 packages of technology
- Technology cost estimates
 - Literature survey – values used based on Plotkin, Greene, and Duleep (2002)

Today's Technology

- Engine improvements
 - Variable valve lift and timing
 - Cylinder deactivation
- Transmission improvements
 - 6-speed AT
- Air conditioning improvements
 - Enhanced HFC-134a system
- Vehicle load reduction
 - Aerodynamic drag reduction
 - Rolling resistance reduction

Advanced Technology

- Engine improvements
 - Advanced stoichiometric direct-injection
 - Cylinder deactivation
- Transmission improvements
 - 6-speed AT without a torque converter
- Air conditioning improvements
 - HFC-152a air conditioning system
- Vehicle load reduction
 - Further aerodynamic drag reduction
 - Further rolling resistance reduction
- 42 Volt integrated starter generator – idle off

Large Car Results

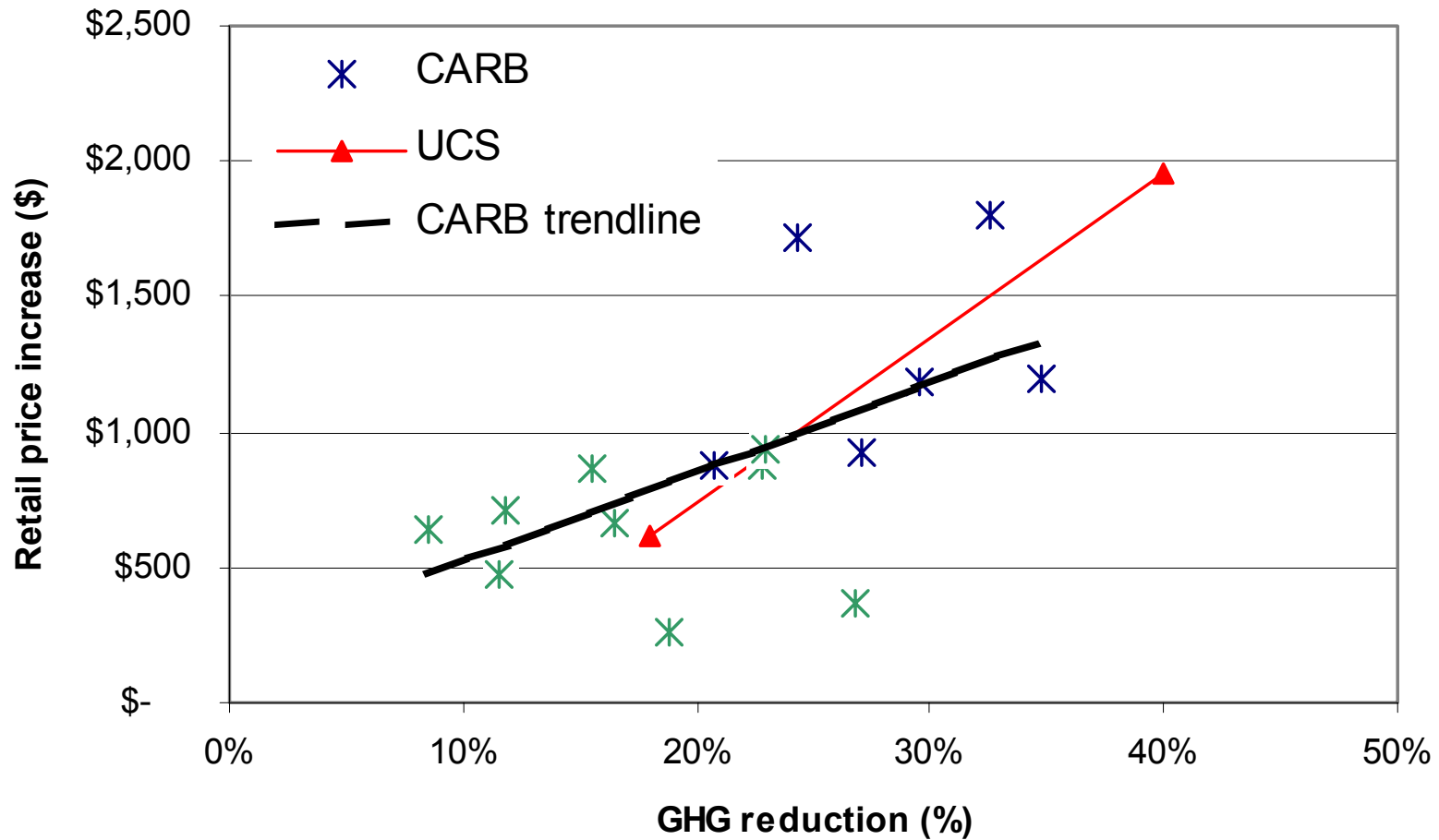
Base vehicle: 2003 V6 Toyota Camry

	Today's technology	Advanced technology
Base Emissions* (g CO ₂ -eq/mi)	334.2	334.2
Modeled Emissions (g CO ₂ -eq/mile)	270.8	196.8
Reduction (%)	19%	41%
Retail price increase (\$)	\$620	\$1,960
Payback time (years) [‡]	3.9	4.8

*Adjusted to include CH₄, N₂O, HFC-134a, and indirect a/c emissions

[‡]Calculated using EMFAC VMT, 16 year life, 5% discount rate (real)

UCS and CARB Large Car Results



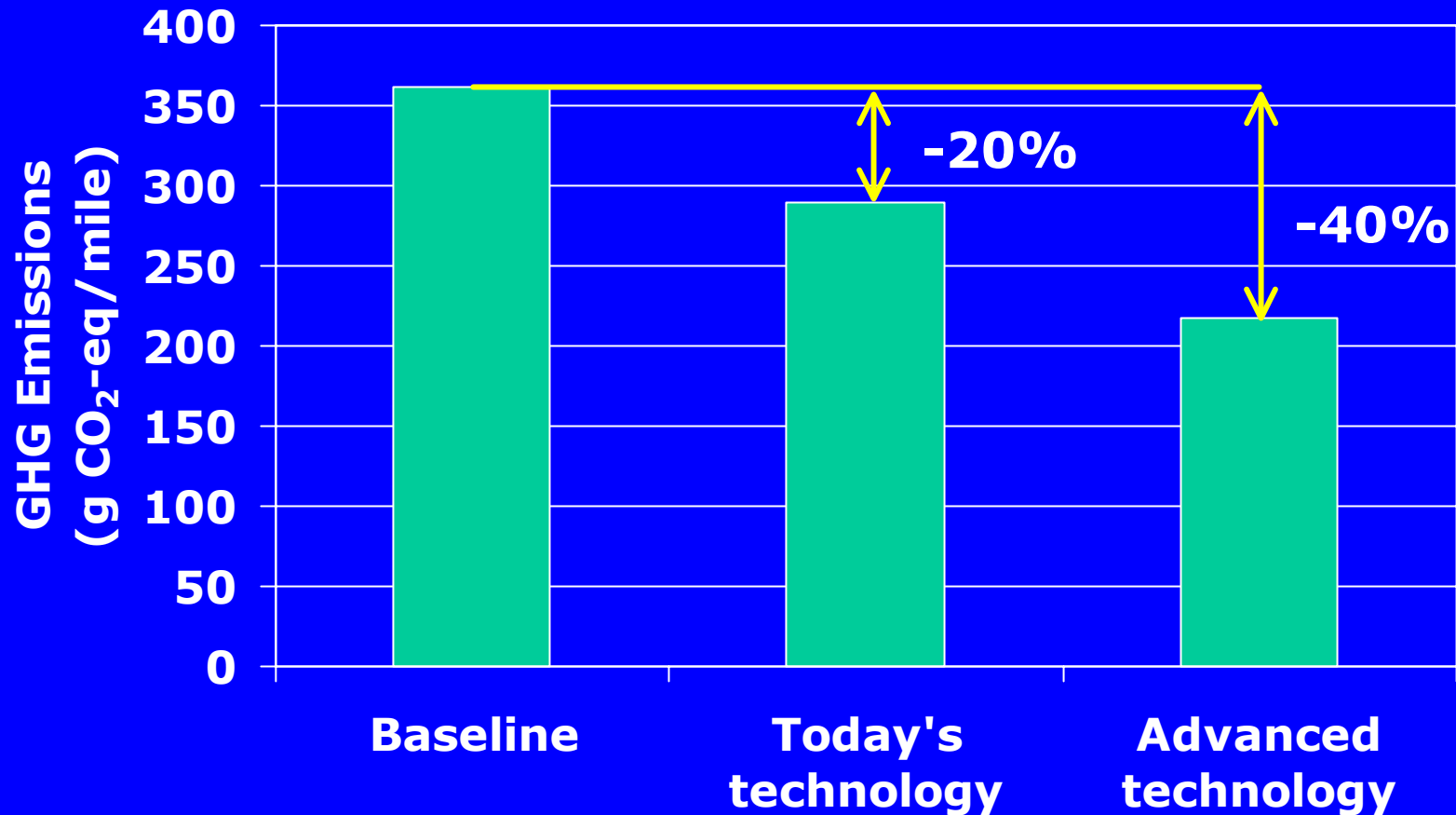
*Includes CARB near- and mid-term technologies, no hybrids

Other Vehicle Classes

	Small car*	Minivan	SUV	Pickup Truck
Base emissions (g CO2-eq/mi)	292.9	368.6	440.0	487.1
	Today's Technology			
Reduction (%)	18%	18%	24%	21%
Payback time (yrs)	3.8	3.8	1.9	2.3
	Advanced Technology			
Reduction (%)	39%	36%	43%	39%
Payback time (yrs)	5.2	5.1	3.2	3.5

* CVT used rather than 6 speed A/T in both cases, no cylinder deactivation

Fleet reductions



*Estimated using fleet mix data from CALCARS

Conclusions

- Technology is available to reduce emissions
- Reductions are cost effective to the California consumer
- Results from CARB, UCS, and others support strong standards for California's new passenger vehicle fleet